N83447.AR.000444
NAS FORT WORTH
5090.3a

FINAL TECHNICAL MEMORANDUM SOIL GAS SAMPLING AT SOLID WASTE MANAGEMENT UNIT 29 NAS FORT WORTH TX

5/1/1999

HYDROGEOLOGIC

File: 17G
P.W.

NAVAL AIR STATION FORT WORTH JRB CARSWELL FIELD TEXAS

ADMINISTRATIVE RECORD COVER SHEET

AR File Number 481

HYDRO GeoLogic INC.

FINAL
TECHNICAL MEMORANDUM
SOIL GAS SAMPLING
SWMU 29
RCRA FACILITY INVESTIGATION
NAS FORT WORTH JRB, TEXAS

Prepared for
U.S. Air Force Center for Environmental Excellence
Brooks AFB, Texas

Contract Number F41624-95-D-8005

May 1999

HydroGeoLogic, Inc.
1155 Herndon Parkway
Suite 900
Herndon, Virginia 20170
(703) 478-5186

FINAL
TECHNICAL MEMORANDUM
SOIL GAS SAMPLING
SWMU 29
RCRA FACILITY INVESTIGATION
NAS FORT WORTH JRB, TEXAS

Prepared for

U.S. Air Force Center for Environmental Excellence
Brooks AFB, Texas

Contract Number F41624-95-D-8005

Prepared by

HydroGeoLogic, Inc.
1155 Herndon Parkway, Suite 900
Herndon, VA

May 1999

REPORT DOCUMENTATION PAGE

Form Approved

QMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	May 1999	Final

4. TITLE AND SUBTITLE

Final Technical Memorandum
Soil Gas Sampling
SWMU 29
RCRA Facility Investigation
NAS Fort Worth JRB, Texas

4. FUNDING NUMBERS

F41624-95-D-8005
Delivery Order 0005

6. AUTHOR(S)

HydroGeoLogic, Inc

7. PERFORMANCE ORGANIZATION NAMES(S) AND ADDRESS(S)

HydroGeoLogic, Inc.
1155 Herndon Parkway, Suite 900
Herndon, VA 20170

8. PERFORMANCE ORGANIZATION REPORT NUMBER

AFC001

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(S)

AFCEE/ERD
Brooks AFB, Texas
78235-5328

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

This document presents the rational for soil and soil gas sampling at SWMU 29. The objective of this sampling is to determine the source of petroleum-impacted soils at SWMU 29.

14. SUBJECT TERMS

15. NUMBER OF PAGES

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE.	19. SECURITY CLASSIFICATION OF ABSTRACT.	20. LIMITATION OF ABSTRACT

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

AOC	area of concern
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and total xylenes
DQO	Data Quality Objective
GC/FID	gas chromatography/flame ionization detector
JP-4	Jet Petroleum No. 4
LCS	laboratory control sample
LPST	Leaking Petroleum Storage Tank
MTBE	Methyl *tert*-butyl ether
NAS Fort Worth, JRB	Naval Air Station Fort Worth, Joint Reserve Base
NAVY	U.S. Navy
PID	photoionization detector
PAH	polycyclic aromatic hydrocarbon
QA/QC	Quality Assurance and Quality Control
QAPP	Quality Assurance and Project Plan
RAP	Remedial Action Plan
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RPM	Remedial Project Manager
SDG	sample delivery group
SVOC	semi-volatile organic compound
SW	solid waste
SWMU	solid waste management unit
TNRCC	Texas Natural Resources Conservation Commission
TPH	total petroleum hydrocarbons
USEPA	U.S. Environmental Protection Agency
UST	underground storage tank
VOA	volatile organic analysis
VOC	volatile organic compound

FINAL
TECHNICAL MEMORANDUM
SOIL GAS SAMPLING
SWMU 29
RCRA FACILITY INVESTIGATION
NAS FORT WORTH JRB, TEXAS

1.0 INTRODUCTION

As part of a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at solid waste management unit (SWMU) 29 located at Naval Air Station Fort Worth, Joint Reserve Base (NAS Fort Worth JRB), Fort Worth, Texas, this Technical Memorandum describes the finding of petroleum-impacted soils and proposes additional sampling to delineate the source and extent of these contaminated soils. This RFI is required by the NAS Fort Worth JRB Municipal Hazardous Waste Management Site Permit No. HW50289 issued by the Texas Water Commission to the former Carswell Air Force Base in February 1991. Figure 1.1 depicts the location of SWMU 29 at NAS Fort Worth JRB.

A total of 23 continuous-core soil borings and 4 monitoring wells were installed at SWMU 29 during field activities conducted in March through May 1998 (Figure 1.2). Three of the soil borings were over-drilled and converted to monitoring wells: BHGLTA208 became WHGLTA201; BHGLTA216 became WHGLTA203; and BHGLTA218 became WHGLTA204. Four soil borings (BHGLTA201, BHGLTA202, BHGLTA204, and BHGLTA206) were used to collect 4 surface and 12 subsurface soil samples. The soil and groundwater sampling conducted at SWMU 29 conforms with the RFI Work Plan (HydroGeoLogic, 1998a), and the Final Basewide Quality Assurance Project Plan (QAPP) (HydroGeoLogic, 1998b). Soil and groundwater samples were analyzed for the full suite of Appendix IX compounds and *cis*-1,2-dichloroethylene using U.S. Environmental Protection Agency (USEPA) solid waste (SW) analytical methods, as required by the Permit.

Potential releases to the environment were found during the initial Appendix IX screening of soils. In addition, free phase petroleum product was found in the vadose zone at boring BHGLTA210. Results of this soil sampling event are summarized in a Technical Memorandum submitted by HydroGeoLogic in December 1998 (HydroGeoLogic, 1998c). Proposed delineation of soils contamination encountered during the initial Appendix IX screening of soils is summarized in the December 17, 1998 Remedial Project Manager (RPM) meeting minutes (HydroGeoLogic, January 11, 1999).

In January 1999, seven additional borings were completed to delineate soil contamination at SWMU 29 (BHGLTA224 through BHGLTA230 on Figure 1.2). The locations of all SWMU 29 soil borings and monitoring wells, as well as local groundwater flow directions, are presented in Figure 1.2. Although information obtained from some of the borings can be used for delineation, this field effort did not directly include characterization of the petroleum product found in

BHGLTA210. This Technical Memorandum describes the effort necessary to identify the source of the petroleum product that has impacted soils in the vicinity of boring BHGLTA210.

1.1 INVESTIGATION FINDINGS AND OBJECTIVES

The purpose of this investigation is to define the source, nature, and extent of the petroleum-impacted soils found at BHGLTA210, and determine if the petroleum contamination is associated with landfill activities.

Initial RFI findings are summarized below:

- Boring BHGLTA210 is located in very close proximity to an underground water utility line (2 to 5 feet away) supplying the base fire hydrant system. This water line leads to a petroleum fueling station which is located approximately 800 feet to the northeast (Figure 1.3). Petroleum-stained soils and associated strong odors were first encountered in the vadose zone at a depth of approximately 7 feet below ground surface (bgs) in boring BHGLTA210. The stained soil and odor had the appearance of relatively fresh gasoline. The petroleum-stained soils were present in vadose zone soils to a depth of 18 feet bgs where the groundwater table was first encountered. A temporary piezometer was installed in this boring and periodically monitored with an interface probe over a 2 week period. A petroleum sheen with a golden brown color was always present on the probe during periodic monitoring, but no accumulation of product greater than 0.01 feet was measured.

- No free phase or dissolved phase petroleum compounds were found in monitoring wells located downgradient of SWMU 29 (WHGLTA201, WHGLTA202, and WHGLTA203) or in the upgradient monitoring well WHGLTA204 (Figure 1.2). No petroleum-impacted soils were found in borings located near BHGLTA210: BHGLTA224, located 90 feet to the southwest; BHGLTA202, located 175 feet northeast; BHGLTA211, located 190 feet east; and BHGLTA209, located 290 feet west. Borings BHGLTA211 and BHGLTA209 are located within 10 feet of an underground water utility line and an electric line (Figure 1.3).

- Petroleum-impacted soils were found at BHGLTA201 from a depth of 5 feet bgs to the water table. Elevated concentrations of semi-volatile organic compounds (SVOCs) were found at depths of 5, 10, and 15 feet. The SVOCs found at BHGLTA201 indicate the presence of asphalt possibly mixed with a heavy petroleum-product. No volatiles were detected in any of the soil samples collected at BHGLTA201. Groundwater was encountered at approximately 15 feet bgs. No petroleum product was found at the water table.

- Petroleum odors were noted at the water table in BHGLTA206 and BHGLTA223. Petroleum stained soils and odors were noted in the vadose zone at approximately 7 feet bgs in BHGLTA206; however, no petroleum stained soils or odors were noted in the vadose zone in BHGLTA223. These borings are located downgradient of a 15,000 gallon heating oil underground storage tank (UST) formerly located

adjacent to Building 1050. The UST was removed by the U.S. Navy's (Navy) contractor, Sunbelt Industrial Services, in September 1998. It appeared to be in good condition and analytical results of soil samples collected from the UST excavation indicated no significant petroleum-impacted soils (Sunbelt Industrial Services, 1998). The former UST was located in the grassy area between BHGLTA219 AND BHGLTA206. An underground water utility line is also located in very close proximity to the former UST and soil borings BHGLTA206, BHGLTA210, BHGLTA223, and the UST (Figure 1.3).

- No petroleum-impacted soils were encountered during the January 1999 field effort to delineate pesticides, metals, and polycyclic aromatic hydrocarbons (PAHs) found in the vicinity of SWMU 29. Boring BHGLTA224 was located across the road, approximately 90 feet southwest of BHGLTA210. Boring BHGLTA228 was located approximately 400 feet northeast. Both of these borings were located within 10 feet of an underground water utility line.

Several hypotheses have been formulated regarding the origin of the petroleum product found in BHGLTA210. These hypotheses are presented below in decreasing order of confidence:

1. **The petroleum product is migrating along an underground utility line (water, electric, or communications) to BHGLTA210.** This hypothesis is supported by the close proximity of BHGLTA210 to the underground utilities, the freshness of the product, and its initial discovery 7 feet bgs in the vadose zone (11 feet above the water table). It also accounts for the lack of dissolved petroleum compounds in the landfill monitoring wells. Examples of potential sources of the petroleum products and underground utility migration routes are presented in Figure 1.3 and described below:

   - **The petroleum fueling station adjacent to Building 1064**: This facility operates two 10,000-gallon gasoline USTs, two 10,000-gallon diesel USTs, and an oil-water separator. Underground water utility lines are located in close proximity to the petroleum fueling station. The current USTs were installed in January 1989, replacing a similar set of USTs which were removed in October 1988. This site and another site located at NAS Fort Worth JRB was assigned the leaking petroleum storage tank (LPST) number 100485; however as only minor soil contamination was found at the petroleum fueling station during the UST removal process, a remedial action plan was not required for this site (HydroGeoLogic, 1998d).

   - **The former diesel UST located adjacent to Building 1040**: This 400 gallon UST provided fuel for an auxiliary electric generator used as a backup at the water-fire pump house facility (Building 1040). Several water lines pass very close to Building 1040 and the former diesel tank. The tank was removed in 1994. The Navy reported a clean closure; however final closure from the TNRCC is still pending (HydroGeoLogic, 1998d). The site is to be investigated by HydroGeoLogic in 1999 under Delivery Order 16, Site Characterizations, USTs, NAS Fort Worth JRB.

- **The former heating oil UST located south of Building 1050**: This tank was removed by the Navy in October 1998. It is located approximately 300 feet to the north northwest of BHGLTA210. A water line is located very close to this tank.

- **The storm sewer system draining the flightline**: Any spill of petroleum products used to fuel or maintain aircraft could be transported via the storm sewer system to SWMU 29. The flightline storm sewer utility crosses the southwest portion of SWMU 29 near BHGLTA201 and BHGLTA210.

2. **The petroleum product originated from an isolated vehicle spill along the road at BHGLTA210.** This hypothesis is supported by the observation of parked vehicles adjacent to BHGLTA210 and also accounts for the lack of dissolved petroleum compounds in other landfill monitoring wells. A lower level of confidence is associated with this hypothesis based on the lack of petroleum odors and staining in the soil from the ground surface to 7 feet bgs.

3. **The petroleum product has migrated to BHGLTA210 via the groundwater.** BHGLTA210 is located downgradient of the flightline where petroleum products are dispensed. BHGLTA210 is also located approximately 300 feet downgradient of the heating oil UST removed by the Navy in 1998. Strong fuel odors were noted at the water table (17 feet bgs) at boring BHGLTA223 downgradient of this tank. (See Figure 1.2 for groundwater flow directions.) Black-stained soil and fuel odors were noted in BHGLTA205 from 6.5 feet bgs to the water table (approximately 14 feet bgs). A very low level of confidence is associated with the groundwater migration hypothesis as it does not account for fresh product in the vadose zone, 11 feet above the water table; and no free product was found at BHGLTA223. Additionally, a golden brown light fraction petroleum product was observed at BHGLTA210. The UST removed by the Navy in 1998 contained heating oil which is characterized as a black heavy fraction petroleum product.

4. **The petroleum product originates east of BHGLTA210 from the Fuel Tanker Parking Lot** (Figure 1.2). There are several drawbacks to this hypothesis: Boring BHGLTA210 is upgradient of this area and no dissolved petroleum compounds are found in monitoring wells (WHGLTA201, WHGLTA202, and WHGLTA203) located between the landfill and the fuel tanker parking lot. Also, it does not account for fresh product 11 feet above the water table in the vadose zone.

5. **The petroleum product originates from the landfill**. BHGLTA210 is located adjacent to and downgradient of SWMU 29. Contaminated soils used as fill in SWMU 29 could account for the petroleum product found at BHGLTA210. However, as the period of operation for SWMU 29 was between 1952 and 1956, any fill material containing petroleum products would have been extemely degraded by weathering processes over the 43 year period. A very low level of confidence can be associated with this hypothesis based on the freshness of the petroleum product found in BHGLTA210.

6. **The petroleum product originates from an unanticipated source**. Each of the above hypothesis presents a potential origin for the petroleum product found in BHGLTA210. However, unforseen and unexpected sources may be responsible for the petroleum product.

1.2 INVESTIGATION STRATEGY

The primary objectives for this investigation are to determine the nature and define the source of petroleum-impacted soils found at BHGLTA210. These objectives will be achieved using the screening-level data obtained from a soil gas survey, in conjunction with definitive data obtained from sampling the petroleum-impacted soils. Screening-level data are appropriate to achieve the Data Quality Objectives (DQOs) because they are designed to determine the direction the petroleum product originated from and the nature of the product, whether a light- or heavy-petroleum distillate. The definitive data obtained by sampling the actual petroleum product will further support the objective of identifying the type of petroleum product.

A continuous core direct push boring will be installed adjacent to BHGLTA210 (Figures 1.4 and 1.5). The soil sample with the highest photoionization detector (PID) reading and another just above the water table will be collected from this boring and submitted to the laboratory for product identification.

A soil gas survey will be performed to determine if petroleum migration via underground utilities is a potential source. Because the primary hypotheses assumes that the petroleum product found at boring BHGLTA210 is migrating along an underground utility line, intrusive activities beyond 2 to 3 feet bgs may risk damage to the adjacent high pressure water line. This risk can be avoided by the use of a shallow soil gas survey prior to any intrusive activities along utilities. Soils in the survey area are generally composed of 14 feet of silty sandy clay overlying 4 feet of gravely sand and 4.5 feet of sandy gravel with limestone bedrock at approximately 22.5 feet bgs. Groundwater occurs at approximately 18 feet bgs. Given the type of soil, depth to groundwater, product type and freshness, a passive soil gas survey would provide the most information without damaging utilities.

Information obtained from the soil gas survey will be used to determine the nature of the petroleum product, identify possible sources of contamination, and locate potential hot spots for intrusive investigation. A total of 20 soil gas sampling locations are planned along a 100 foot by 50 foot grid centered on boring BHGLTA210. The grid will be laid out with a bias toward the underground water utility that may act as a pathway for contaminant transport (Figure 1.4). The soil gas grid will also encompass all contaminant migration directions in the vicinity of BHGLTA210 (Figure 1.5).

After completion of the soil gas survey and soil sampling, the results will be reviewed to determine the source of the petroleum-impacted soil. If the source is determined to be SWMU 29, an additional field effort using definitive data will be necessary to delineate the extent of contamination. If it is determined that SWMU 29 is not the source of the petroleum-impacted soils, contaminant delineation and subsequent remediation, if necessary, will be handled either by the Navy or the Air Force under TNRCC's Leaking Petroleum Underground Storage Tank program.

2.0 SAMPLING METHODOLOGY

2.1 SOIL SAMPLING

Soil sampling will be conducted in accordance with the RFI Work Plan (HydroGeoLogic, 1998a).

2.2 PASSIVE SOIL GAS SAMPLING METHODOLOGY

Passive soil gas methods commonly use an activated carbon adsorbent placed in the shallow subsurface to collect volatile organic compounds (VOCs) over an interval of time. Analytical results are generally reported in mass per time, flux, or ion counts. The EMFLUX® passive soil gas system has been chosen as the primary soil gas method because sample collectors can be placed 6 inches bgs and analytical results can be converted into mass per volume results.

Soil gas results are generally considered to be for screening purposes. Soil gas collected at the surface may originate from multiple matrices such as free product, dissolved or adsorbed phase compounds. Soil gas can also migrate great distances through the soil based on pressure gradients and variable soil permeabilities.

The following procedures are routinely used during EMFLUX® soil gas surveys. USEPA-approved Quality Assurance and Quality Control (QA/QC) practices will be followed.

A. HydroGeoLogic field personnel will carry EMFLUX® system components and support equipment to the site and deploy the EMFLUX® collectors in a prearranged survey pattern. Each collector emplacement generally takes less than 2 minutes. A two person crew will deploy the collectors. Navy Public Works will be contacted prior to initiating soil gas activities and a dig permit will be obtained.

B. For those sample locations covered with soils or vegetation, HydroGeoLogic's technician shall clear vegetation and debris to expose the ground surface. Using a hammer and a 0.75-inch diameter pointed metal stake, the technician will create a hole approximately 6 inches deep. For those locations covered with an asphalt or concrete cap, the field technician will drill a 1.5-inch diameter hole through the cover to access the soils beneath. (If necessary, the collector can be sleeved with a 0.75-inch inside diameter copper pipe for either paved or unpaved locations.)

C. The solid plastic cup will be removed from an EMFLUX® collector and replaced with a sampling cap. The technician will insert the collector, with the sampling cap end facing down, into the hole (Figure 2.1). The collector is covered with either local soils for uncapped locations or aluminum foil and a concrete patch for capped locations. The collector's number; location; time and date of emplacement; soil description; presence of asphalt; cartridge/vial condition; and other relevant information are recorded in the field logbook.

D. As a quality-control check during emplacement and retrieval, the technician will collect periodic ambient-air control samples and record the date, time and location of each. One or more trip blanks are included as part of the QC procedures.

E. Approximately 72 hours after emplacement of the EMFLUX® collectors, field personnel will remove the collectors. At each location, a field technician will withdraw the collector from its hole and wipe the outside of the vial clean using a gauze cloth; after removal of the sampling cap, the threads of the vial will be cleaned. A solid plastic cap will be screwed onto the vial and the sample location number will be written on the label. The technician will then records sample point location, date, and time in the field logbook.

F. Sampling holes will be refilled with soil, sand, or other suitable material. If the collectors have been installed through asphalt or concrete, the hole will be filled to grade with a plug of cold patch or cement.

G. Following retrieval, field personnel will ship the EMFLUX® collectors to an EMFLUX® designated analytical laboratory.

- All analysis of laboratory QC samples shall be performed at the frequency required by the method requested.
- All analyses will be performed on an instrument exhibiting acceptable linearity from an initial calibration using at least three non-zero calibration standards.
- Ambient blanks will be required.
- Trip blanks will be required.
- At least one surrogate shall be added to all samples for all organic analyses, even if not required by the method.
- Results for all samples shall be reported using the HydroGeoLogic designated sample identification numbers.
- Laboratory control sample (LCS) results shall be reported in the same SDG as the associated field sample results.
- In cases where secondary dilutions are performed, both the undiluted and diluted sample results are to be reported.
- In the event of matrix interference or elevated analyte concentration, the minimum dilution is to be performed in order to meet the project-specific reporting limits as closely as possible.

3.6 REPORTING

If the source of petroleum-impacted soils is determined to be SWMU 29, this work will be reported as part of the SWMU 29 RFI after potential confirmation borings are installed. However, if the soil gas and soil sampling indicate a source other than SWMU 29, then information obtained from this investigation will be provided in a brief summary letter report for further investigation of the source area.

4.0 REFERENCES

HydroGeoLogic, January 11, 1999. Minutes of Remedial Project Managers meeting held in San Antonio, Texas, December 17,1998.

HydroGeoLogic, 1998a. Final Work Plans, RCRA Facility Investigation of Landfills NAS Fort Worth JRB, Texas.

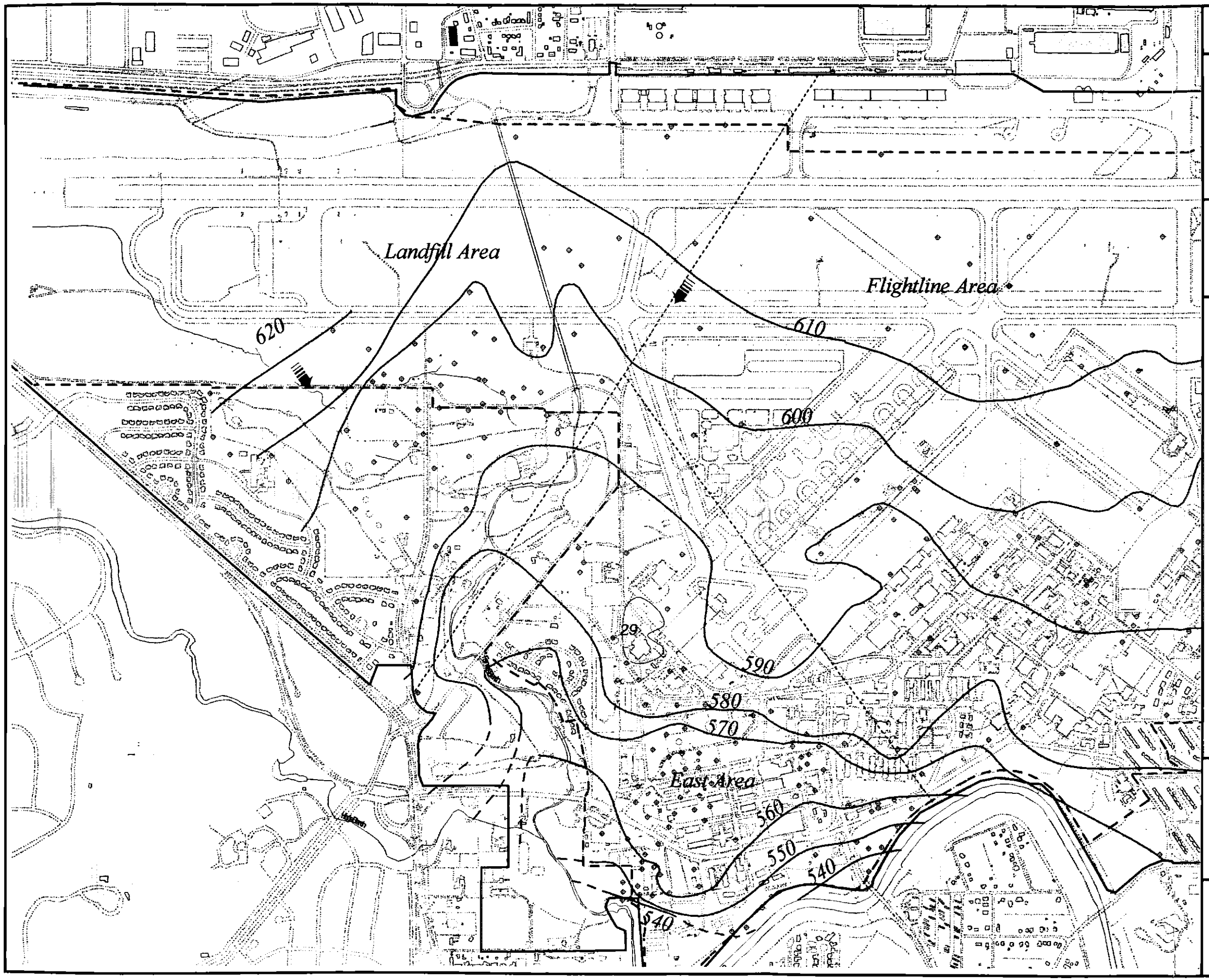
HydroGeoLogic, 1998b. Final Basewide Quality Assurance Project Plan, NAS Fort Worth JRB, Texas.

HydroGeoLogic, 1998c. Draft Technical Memorandum, Initial Soil Sampling Results, Proposed Additional Sampling SWMUs 17, 26, 27, 29, 30 and 62, RCRA Facility Investigation, NAS Fort Worth JRB, Texas.

HydroGeoLogic, 1998d. Final Technical Memorandum, Recommended Actions Underground Storage Tanks, NAS Fort Worth JRB, Texas.

Texas Water Commission, Permit for Municipal Hazardous Waste Management Site Permit No. HW50289, Texas SWR No. 65004, EPA Permit No. TX05711924042, February, 1991.

Sunbelt Industrial Services, 1998. Underground Storage Tank Removal Report for Building 1050, NAS Fort Worth JRB, Texas.



HydroGeoLogic, Inc.—Final Technical Memorandum, SWMU 29
NAS Fort Worth JRB, Texas

Figure 1.1

Groundwater Flow July 1998 and Location of SWMU 29

Air Force Center For Environmental Excellence
Brooks AFB, Texas

Legend

- NAS Fort Worth JRB (Carswell Field)
- Former Carswell Air Force Base
- 600 Groundwater Elevation Contour (Feet Above Mean Sea Level)
- Generalized Groundwater Flow
- Groundwater Management Areas
- 29 Solid Waste Management Unit 29
- Existing Monitoring Well Location

N

0 500 1000 2000
SCALE IN FEET

HYDRO GeoLogic INC.

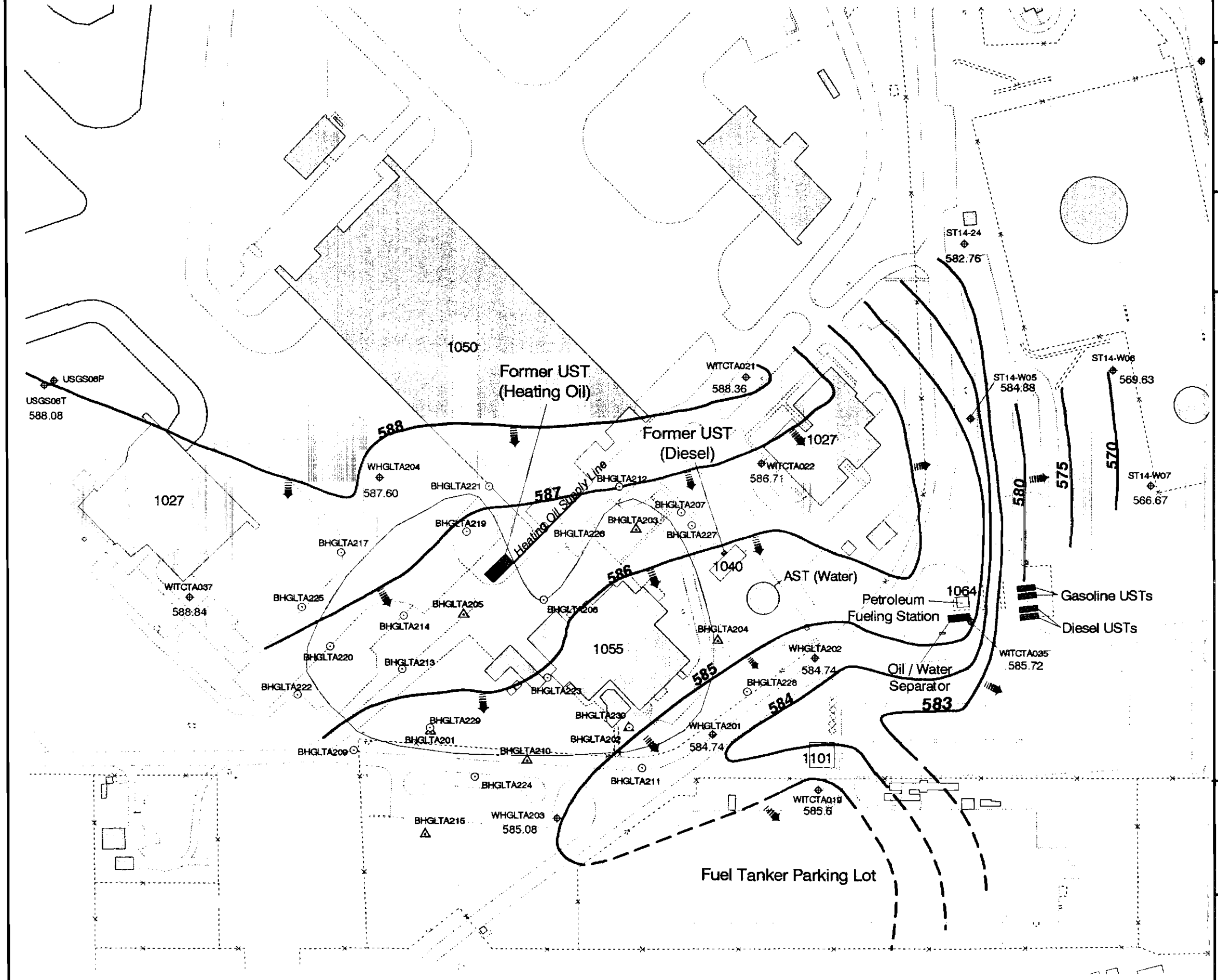
Filename: AFC001/05CEA/swmu_gwflow.apr
Project: AFC001-05CDE
Created: 10/09/98 nzehms
Revised: 04/30/99 ap
Map Source: HydroGeoLogic, Inc GIS Database

HydroGeoLogic, Inc.—Final Technical Memorandum, SWMU 29
NAS Fort Worth JRB, Texas

Figure 1.2

SWMU 29 Sampling Locations and Groundwater Flow January 1999

Air Force Center For Environmental Excellence
Brooks AFB, Texas



Legend

- Landfill Boundaries
- BHGLTA211 — Borehole Location
- BHGLTA202 — Borehole/Piezometer Location
- GMI-22-07M — Existing Monitoring Well Location
- 584.74 — Groundwater Elevation
- 587 — Groundwater Elevation Contour (Feet Above Mean Sea Level)
- Groundwater Flow Direction

N

100 0 100 200
SCALE IN FEET

HYDRO GeoLogic INC.

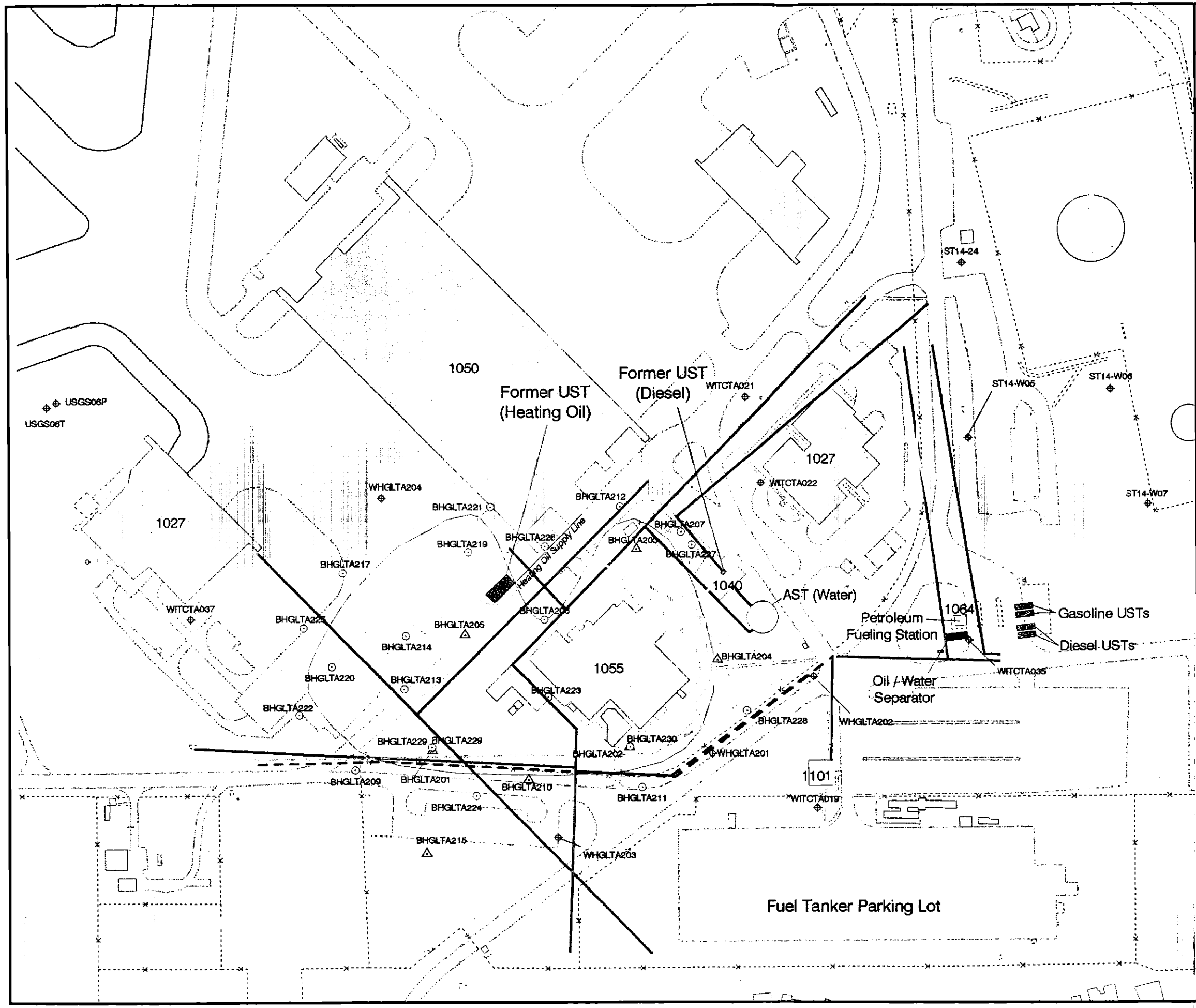
Filename: 05CEA/REPORT/round_2/lf2_samp_locs.apr
Project: AFC001-05CDE
Created: 12/01/98/98 nzehms
Revised: 05/10/99 ap
Map Source: HydroGeoLogic, Inc. GIS Database

HydroGeoLogic, Inc.—Final Technical Memorandum, SWMU 29
NAS Fort Worth JRB, Texas

Figure 1.3

SWMU 29
Utilities and Soil
Boring Locations

Air Force Center For
Environmental Excellence
Brooks AFB, Texas



Legend

- Landfill Boundaries
- BHGLTA211 — Borehole Location
- BHGLTA202 — Borehole/Piezometer Location
- GMI-22-07M — Existing Monitoring Well Location
- Water Utility
- Water Utility (Observed)*
- Gas Utility
- Storm Sewer
- Underground Electric Utility*
- Communication Line*

* Observed during 1998 through 1999 RFI activities

Warning

Locations of utilities shown on this map are approximate and should be used for informational purposes only. Other utilities may be present in this area. No digging or boring activities should be conducted based on this map. Dig permits must be obtained from the NAS Forth Worth Public Works Department.

N

100 0 100 200

SCALE IN FEET

HYDRO GeoLogic INC.

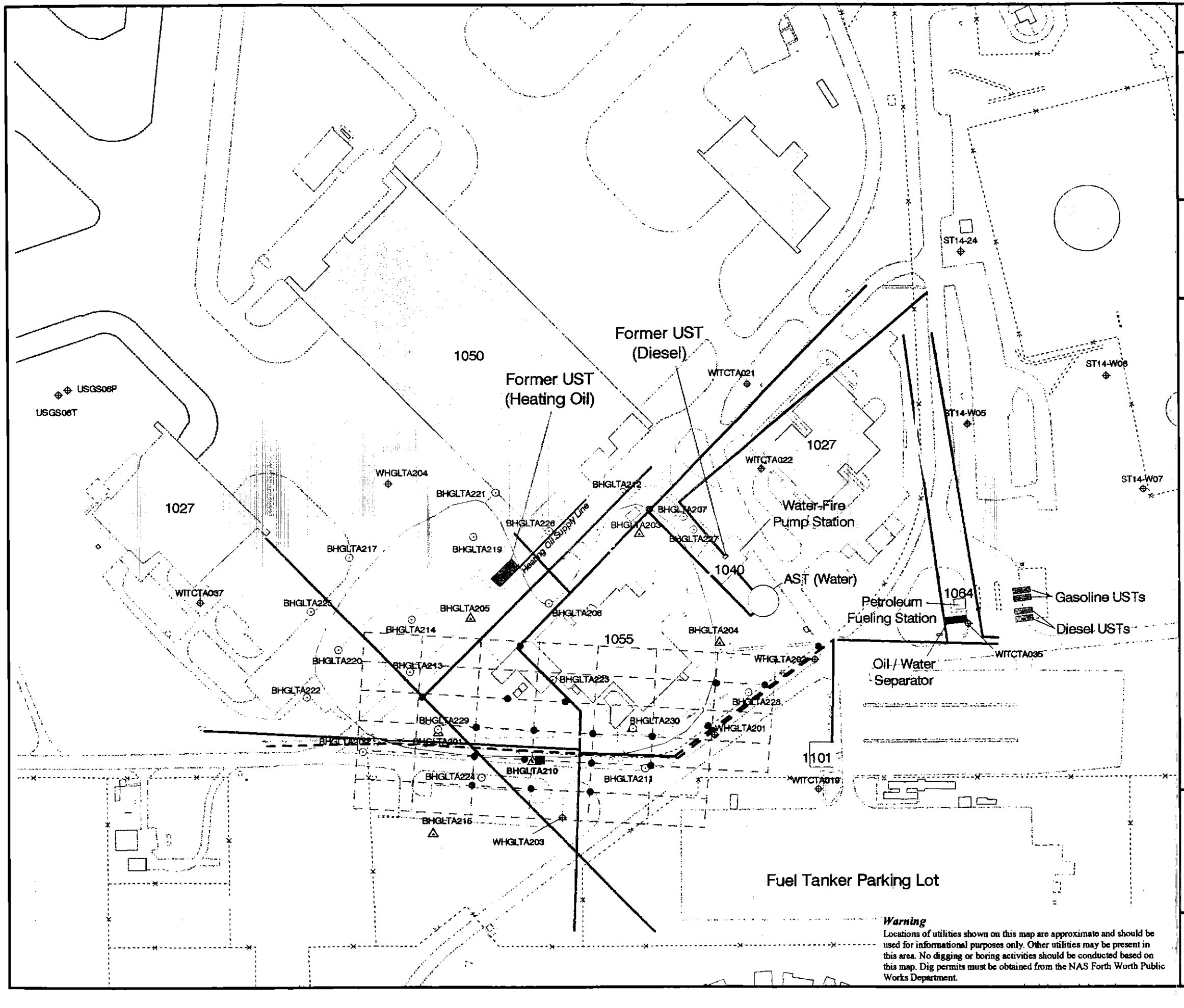
Filename: AFC001\05CDE\Report\soilgas_lf2_revised.apr
Project: AFC001-05CDE
Created: jbelcher 02/03/99
Revised: 04/30/99 ap
Map Source: HydroGeoLogic, Inc. Arcview Database.

HydroGeoLogic, Inc.—Final Technical Memorandum, SWMU 29
NAS Fort Worth JRB, Texas

Figure 1.4

SWMU 29
Proposed Soil Boring and Soil Gas Sampling Locations with Utilities

Air Force Center For
Environmental Excellence
Brooks AFB, Texas



Legend

- Landfill Boundaries
- BHGLTA211 — Borehole Location
- BHGLTA202 — Borehole/Piezometer Location
- GMI-22-07M — Existing Monitoring Well Location
- Proposed Soil Boring Location
- Proposed Soil Gas Sample
- Water Utility
- Water Utility (Observed)*
- Gas Utility
- Storm Sewer
- Underground Electric Utility*
- Communication Line*

* Observed during 1998 through 1999 RFI activities

Note: Grid spacing is 100 feet by 50 feet.

100 0 100 200
SCALE IN FEET

N

Warning
Locations of utilities shown on this map are approximate and should be used for informational purposes only. Other utilities may be present in this area. No digging or boring activities should be conducted based on this map. Dig permits must be obtained from the NAS Forth Worth Public Works Department.

HYDRO GeoLogic INC.

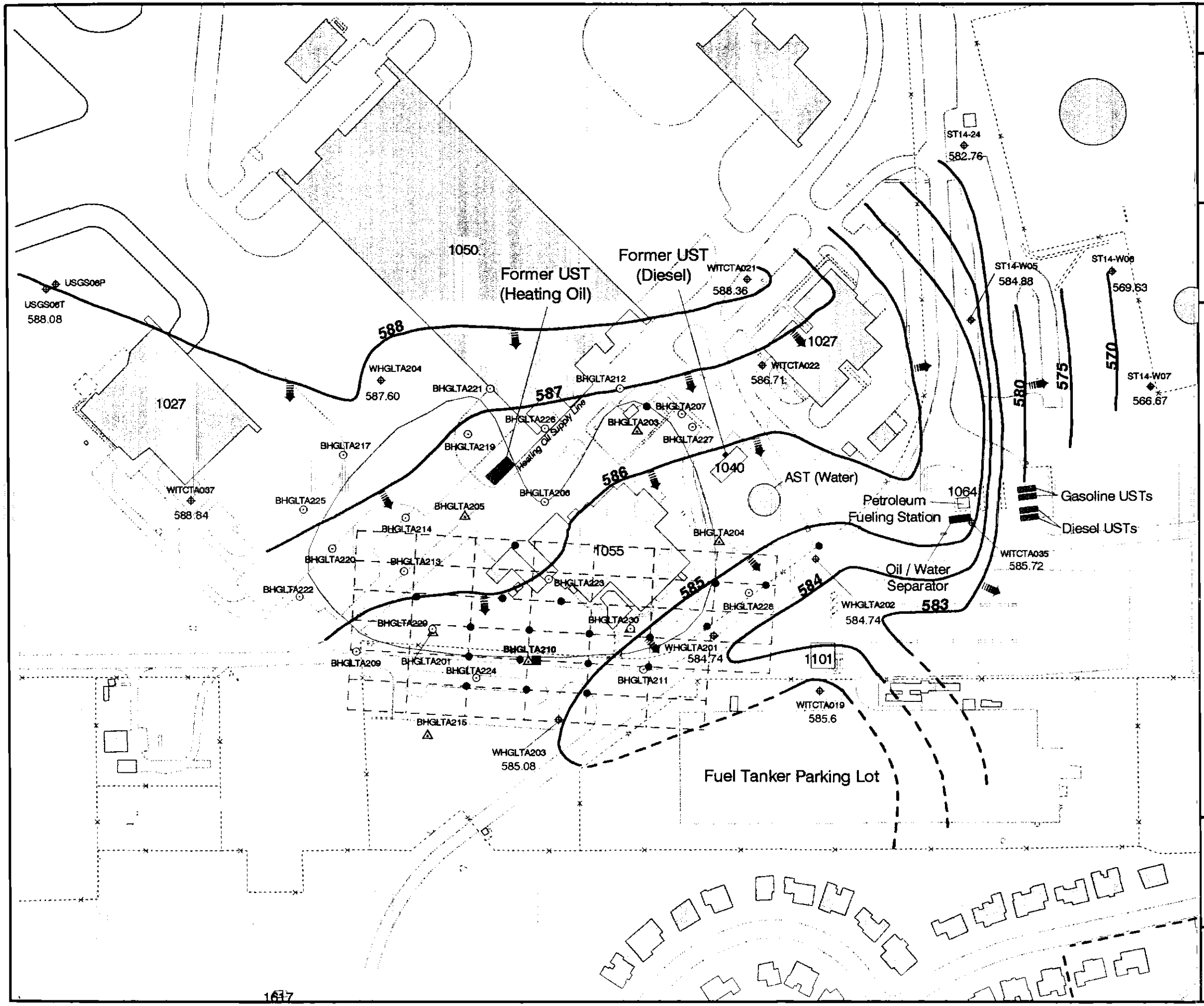
Filename: AFC001\05CDE\Report\soilgas_lf2_revised.apr
Project: AFC001-05CDE
Created: jbelcher 02/03/99
Revised: 04/30/99 ap
Map Source: HydroGeoLogic, Inc. Arcview Database.

HydroGeoLogic, Inc.—Final Technical Memorandum, SWMU 29
NAS Fort Worth JRB, Texas

Figure 1.5

Proposed Soil Gas Sampling Locations and Groundwater Flow January 1999

Air Force Center For Environmental Excellence
Brooks AFB, Texas



Legend

- Landfill Boundaries
- BHGLTA211 — Borehole Location
- BHGLTA202 — Borehole/Piezometer Location
- GMI-22-07M — Existing Monitoring Well Location
- 584.74 — Groundwater Elevation
- Proposed Soil Boring Location
- Proposed Soil Gas Sampling Locations
- 587 — Groundwater Elevation Contour (Feet Above Mean Sea Level)
- Groundwater Flow Direction

Note: Grid spacing is 100 feet by 50 feet.

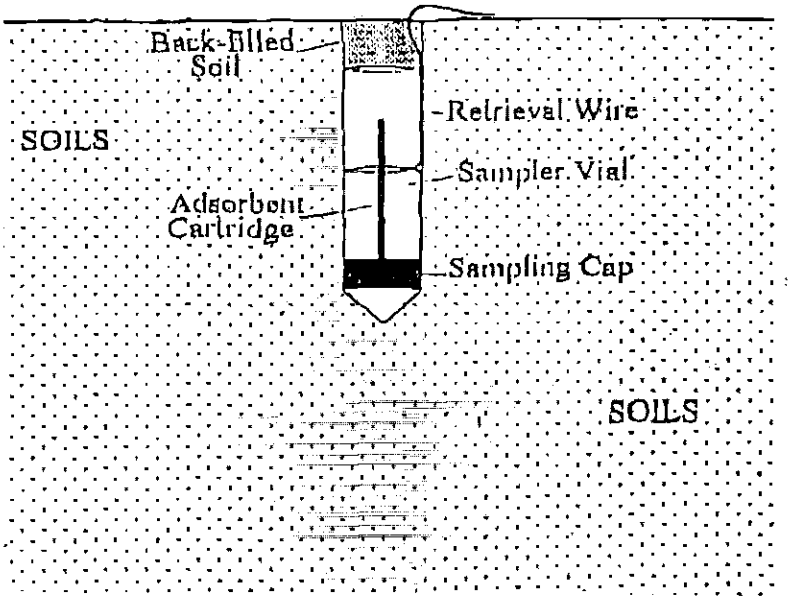
N

100 0 100 200
SCALE IN FEET

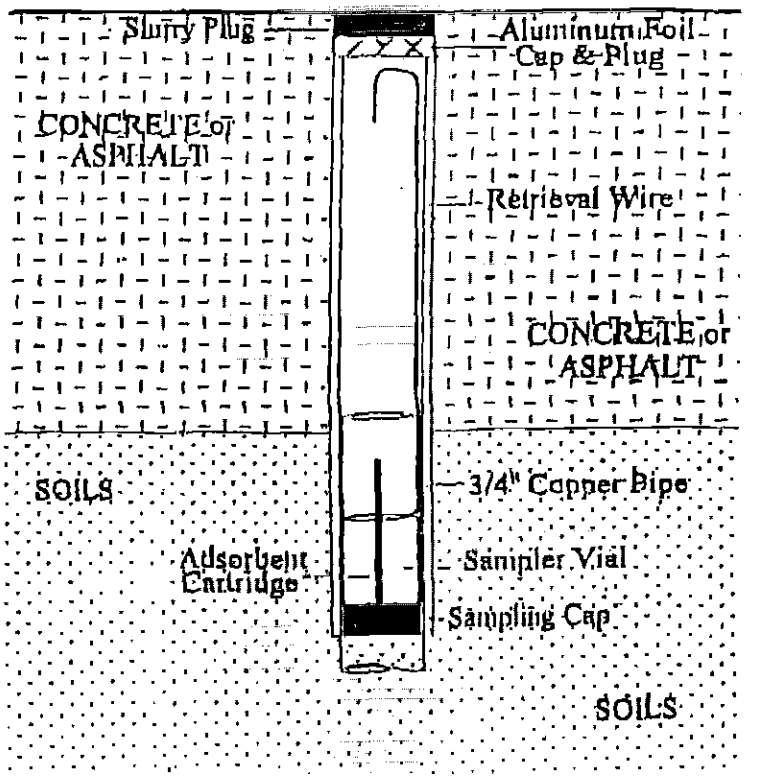
HYDRO GeoLogic INC.

Filename: AFC001\05CDE\Report\soilgas_lf2_revised.apr
Project: AFC001-05CDE
Created: jbelcher 04/12/99
Revised: 05/11/99 ap
Map Source: HydroGeoLogic, Inc. Arcview Database.

Deployment Through Soils



Deployment Through an Asphalt/Concrete Cap



Filename: X:\AFC001\05CDE\Report\Figure_2-1_frame.cdr
Project: AFC001-05CDE

HYDRO GeoLogic

Figure 2.1
EMFLUX® Collector

FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE